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# Five New Species of *Tupistra* (Asparagaceae) from the Malay Peninsula

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Five new species of *Tupistra* from the Malay Peninsula, *T. elegans* N. Tanaka, *T. robusta* N. Tanaka, *T. malaiana* N. Tanaka, *T. kressii* N. Tanaka, and *T. urceolata* N. Tanaka & W. J. Kress, are described, illustrated and compared with closely related congeners. *Tupistra elegans* and *T. robusta* are morphologically close to each other, sharing a sigmoid floriferous stem (including inflorescence), a campanulate perianth with anthers located around the orifice of the tube, and an umbraculate lobed stigma. *Tupistra malaiana, T. kressii* and *T. urceolata* appear to have close affinity, sharing an urceolate perianth with anthers inserted subdistally on the tube. In *Tupistra*, the urceolate perianth is very likely an apomorphy.

Key words: Asparagaceae, Aspidistreae, Convallarieae, Malay Peninsula, *Tupistra elegans*, *Tupistra kressii*, *Tupistra malaiana*, *Tupistra robusta*, *Tupistra urceolata*

*Tupistra* Ker Gawl. (including *Tricalistra* Ridl. and *Gonioscypha muricata* Gagnep.; Asparagaceae), which is morphologically close to both *Aspidistra* Ker Gawl. and *Rohdea* Roth, is usually classified in Aspidistreae Endl. (Endlicher 1836, Kunth 1850, Bentham 1883, Hutchinson 1934, Takhtajan 1997) or in Convallarieae Endl. (Engler 1887, Lotsy 1911, Krause 1930, Conran & Tamura 1998). It comprises about 13 species, and ranges mainly in southern and southeastern Asia, including the eastern Himalaya and Assam (e.g., Hooker 1892), the Malay Peninsula (Ridley 1924), northern Sumatra (Jessop 1979, Tanaka 2003a), Indochina (Gagnepain 1934, as *Gonioscypha*), and southwestern China (Liang 1978).

From the Malay Peninsula, three species of *Tupistra*, *T. grandis* Ridl. (Ridley 1900), *T. violacea* Ridl. (Ridley 1904) and *T. ochracea* (Ridl.) N. Tanaka (Ridley 1909, Jessop 1979, as *Tricalistra*; Tanaka 2003b), have hitherto been recognized (Jessop 1979). They are readily distinguishable with distinct specific features. In reviewing the taxonomy of the genus, I found five additional undescribed species among collections from the peninsula. They are described and illustrated here and compared with closely allied species.

## Materials and Methods

This study was mainly based on herbarium specimens preserved in A, BM, K, P, SING, TEU and US. A living plant of *Tupistra kressii* N. Tanaka, provided by the Botany Department Greenhouses, National Museum of Natural History, Smithsonian Institution, U.S.A. (abbreviated as USBRG; accession number 1999-094), was also examined in the experimental nursery of our university.

## Results

Five new species found in collections from the Malay Peninsula are described, illustrated and compared with closely related congeners. A key to the eight species of *Tupistra* indigenous to the Malay Peninsula, the five new ones plus the three formerly recognized, is also presented below.

In the following descriptions, the term *floriferous stem* is used to include an inflorescence besides its peduncle.

## Key to the species of *Tupistra* of the Malay Peninsula

1a. Floriferous stem erect or sigmoid with upright spike; perianth campanulate; anthers in middle or around orifice of perianth tube ........ 2
  2a. Anthers in middle of perianth tube ........ *T. grandis*
  2b. Anthers around orifice of perianth tube ........ 3
    3a. Perianth usually 6–8 mm across, ochraceous; pistil 4–5 mm long; stigma barely broader than style ........ *T. ochracea*
    3b. Perianth usually more than 1 cm across, purplish (color unknown in *T. robusta*); pistil over 5 mm long; stigma markedly broader than style ........ 4
      4a. Floriferous stem erect; stigma subglobose ........ *T. violacea*
      4b. Floriferous stem sigmoid with upright spike; stigma umbraculate, lobed ........ 5
        5a. Blade of leaf oblanceolate, base attenuate; floriferous stem ca. 24 cm long; bracts 2.5–5 mm broad, bracteoles 1.5–2.5 mm broad; anthers at apex of tube ........ 1. **T. elegans**
        5b. Blade of leaf narrowly oblanceolate, base narrowly cuneate; floriferous stem 52 cm or slightly longer; bracts 6–10 mm broad, bracteoles 4–6.5 mm broad; anthers at base of perianth lobes ........ 2. **T. robusta**
1b. Floriferous stem erect, ascending or reclining; perianth urceolate; anthers subdistal on perianth tube ........ 6
  6a. Floriferous stem ascending or reclining, to 23 cm long ........ 3. **T. malaiana**
  6b. Floriferous stem erect, to 40 cm long ........ 7
    7a. Peduncle with several sterile bracts; spike densely flowered; floral bracts usually exceeding flowers, and appressed to them; perianth nearly zygomorphic, tube dorsiventrally subcomplanate, lobes 5.5–8 mm long; anthers lower than stigma; stigma slightly exserted from perianth tube ........ 4. **T. kressii**
    7b. Peduncle without sterile bracts; spike somewhat laxly flowered; floral bracts usually shorter than flowers and borne slightly apart from them; perianth tube scarcely complanate laterally, lobes 3–6 mm long; anthers nearly as high as stigma; stigma not exserted from perianth tube ........ 5. **T. urceolata**

## Five new species of *Tupistra*

### 1. **Tupistra elegans** N. Tanaka, **sp. nov.** (Figs. 1, 2)

Haec species *Tupistrae violaceae* affinis est, sed ab ea praesertim differt lamina folii oblanceolata basi attenuata (vs. laminam anguste oblanceolatam basi longe cuneata), caule florifero sigmoideo cum spica stricta (vs. caulem floriferum erectum), tubo perianthii infundibuliformi (vs. tubum crateriformem), et stigmate umbraculiformi cum processibus leviter grossioribus, lobato et atromalvino (vs. stigma subglobosum albidum).

*Typus.* [MALAYSIA.] Perak, Belum, between first ridge, sub-camp & G. Kabut Hill, 3500 ft, 22 Feb. 1994, fl., *L. Chua et al. s.n.* (*FRI [=KEP] 40547*) (holo- K).

*Herb* perennial, monopodial, evergreen, glabrous. *Rhizome* erect, cylindrical, stout, ca. 1.5 cm in diam. *Roots* fibrous, to 5 mm in diam. *Cataphylls* several, subulate, to 17 cm long. *Leaves* basal; petiole distinct, 33 cm long; blade oblanceolate or narrowly elliptic-oblanceolate, base attenuate, apex acuminate, to 53 cm long, to 11.7 cm broad, abaxial midvein prominent, lateral longitudinal veins many, fine. *Floriferous stem* 1, axillary, simple, sigmoid; peduncle geniculately ascending, 11.5 cm long, dark purple, distally with 3 short sterile bracts (to ca. 0.9 mm long); spike erect, densely many-flowered, 12.5 cm long. *Bracts* 2 per flower, upper margin membranous; outer bract inserted slightly below flower, cucullate, oblong-ovate, ovate or lanceolate, apically inflexed, 4–7 mm long, 2.5–5 mm broad; inner bract (bracteole) lateral to floral base, oblong or oblong-ovate, 3.5–5 mm long, 1.5–2.5 mm broad. *Flowers* ascending. *Perianth* campanulate, 6-lobed, fleshy; tube infundibuliform, 6–8 mm long, longer than lobes; lobes (narrowly) deltoid-ovate or deltoid, 4.5–6 mm long, 3–4 mm broad, lower lobes more prominently recurved, upper lobes slightly recurved. *Stamens* 6; anthers sessile, inserted at apex of perianth tube, semi-exposed, introrse, oblong, 1.3–1.7 mm long. *Pistil* 1; stigma umbraculate (or fungiform), irregularly lobed, sometimes 3-parted, apical surface with dense minute scaly or papillary projections, 3.5–5.5 mm across, dark mauve (*FRI 40547*); style terete, 7–7.5 mm long; ovary superior, slightly

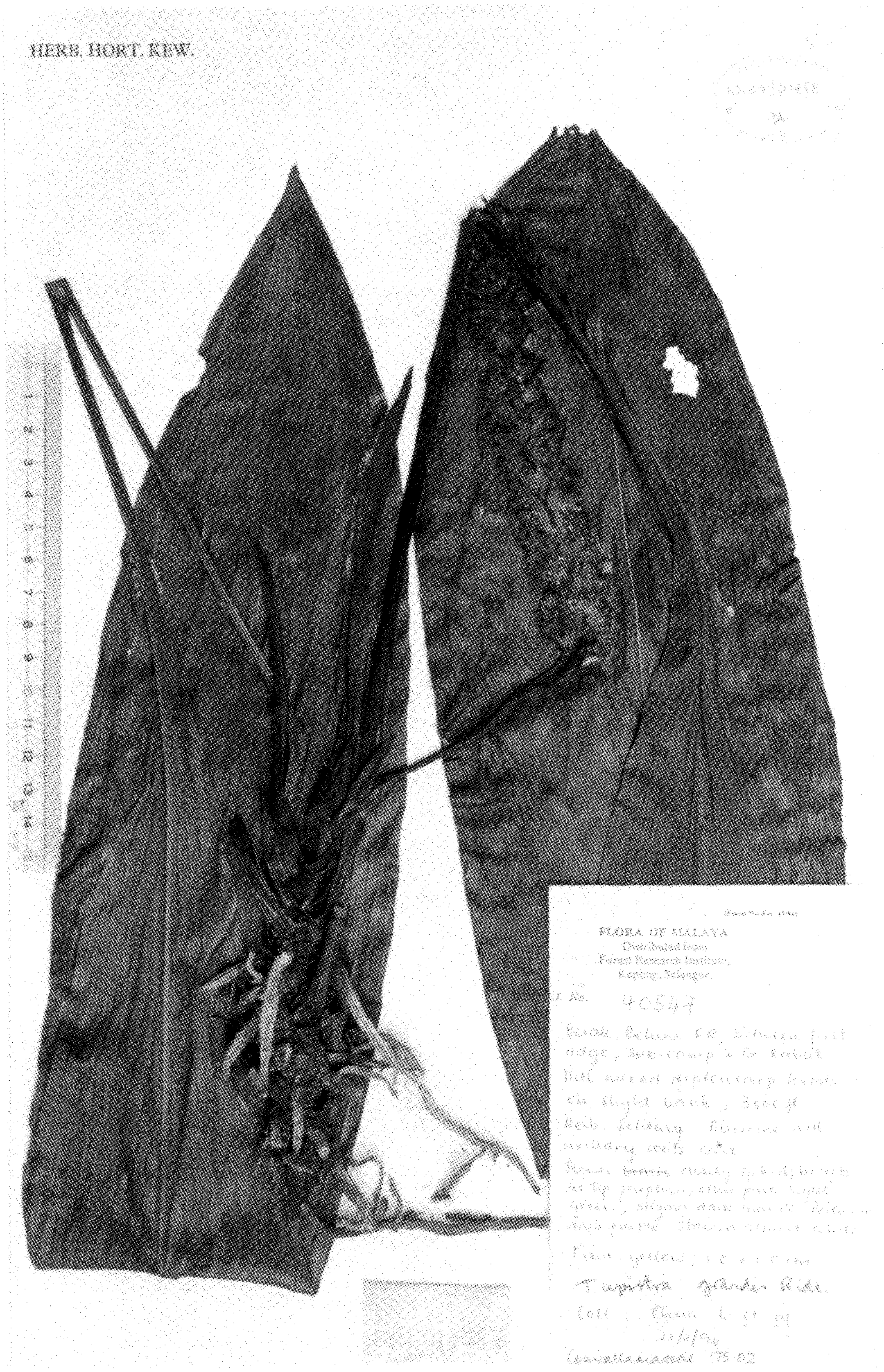

FIG. 1. Holotype of *Tupistra elegans* N. Tanaka from Perak, Malaysia (*Chua & al. s.n., FRI [=KEP] 40547,* K).

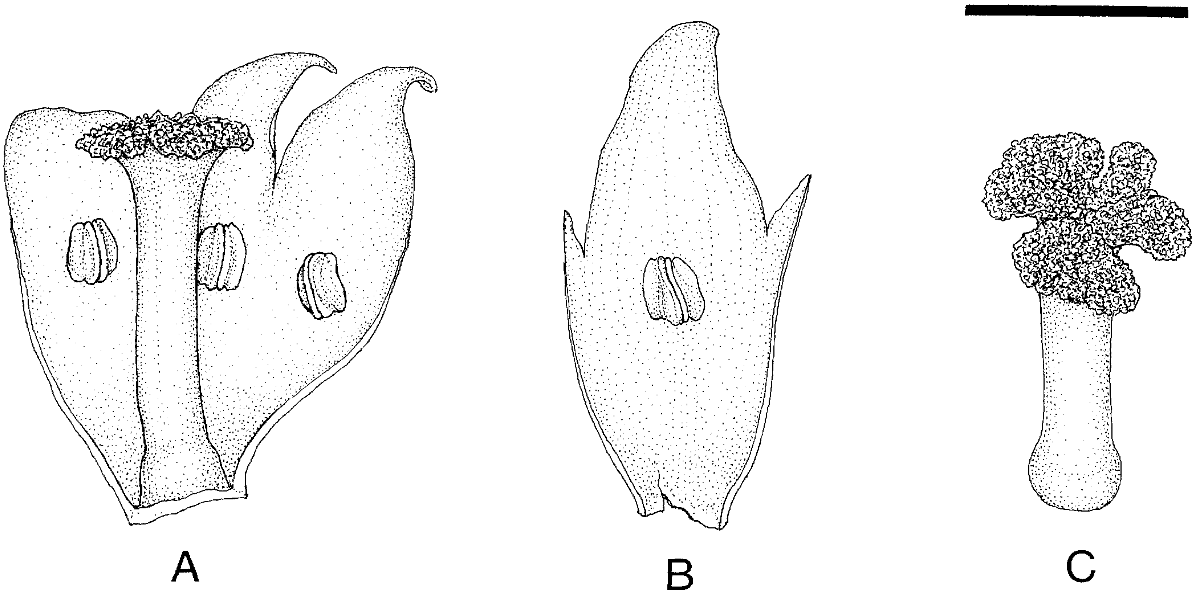

FIG. 2. Partial flower of *Tupistra elegans*. A: flower longitudinally cut with half of perianth bearing three anthers removed. B: part of perianth with anther inserted on distal portion of tube. C: pistil with lobed stigma viewed slightly from above. Scale bar = 5 mm. Drawn from holotype by Noriyuki Tanaka.

broader than style, ca. 1–1.5(–2) mm long. *Fruit* yellow, 1 cm in diam. (*FRI 40547*).

*Flowering*. February.

*Habitat*. Mixed dipterocarp forests, on gently slopes, 3500 ft (*FRI 40547*).

*Distribution*. Malaysia (Perak).

*Notes*. In *Tupistra elegans*, the anthers are located distally on the perianth tube. The fully expanded perianth tends to become slightly torn between the lobes. Because of these secondary tears the anthers appear to be located at the base of the lobes.

### 2. **Tupistra robusta** N. Tanaka, **sp. nov.** (Figs. 3, 4)

Haec species nova *Tupistrae eleganti* proxima est, sed ab ea lamina folii anguste oblanceolata cum basi longe cuneato (vs. laminam oblanceolatam cum basi attenuato), caule florifero longiore, bracteis bracteolisque latioribus, antheris insertis basi lobi perianthii (vs. antheras insertas ad apicem tubi perianthii), et stigmatibus cum rugis (vel processibus) leviter grossioribus diversa est.

*Typus*. [MALAYSIA.] Perak, Gunong Kerbau, 4500 ft, 23 March 1913, fl., *H. C. Robinson s.n.* (holo- K).

*Herb* perennial, evergreen, monopodial, robust, glabrous. *Rhizome* cylindrical, stout, ca. 2 cm in diam. *Roots* fibrous, ca. 3 mm in diam. *Cataphylls* several, subulate. *Leaves* basal; petiole 19–20 cm long; blade narrowly oblanceolate, base narrowly cuneate, to ca. 60–70 cm long, to 10.5 cm broad, abaxial midvein prominently elevated, firm, lateral longitudinal veins numerous, fine. *Floriferous stem* 1, axillary, simple; peduncle sigmoidally ascending, 18 cm long, distally bearing 3 sterile bracts; spike upright, densely many-flowered, to 34 cm or a little longer. *Bracts* 2 per flower, membranous at margin (in sicco); outer one inserted under flower, clasping floral base, cucullate, flabellate or broadly ovate, obtuse and slightly denticulate at apex, several-veined, to 9 mm long, ca. 6–10 mm broad; inner one (bracteole) lateral to floral base, depressed ovate or broadly ovate, 4 mm long, 4–6.5 mm broad. *Flowers* ascending. *Perianth* campanulate, 6-cleft, fleshy; tube hemispheric, somewhat contracted at base, 6–7 mm long; lobes oblong-ovate, obtuse, 6–8 mm long, 3.5–4 mm broad, lower abaxial lobes recurved more strongly than upper adaxial ones. *Stamens* 6; anthers sessile, inserted at base of perianth lobes, exposed, introrse, oblong, 1.5–1.7 mm long. *Pistil* 1, 7–10 mm long; stigma umbraculate (or fungiform),

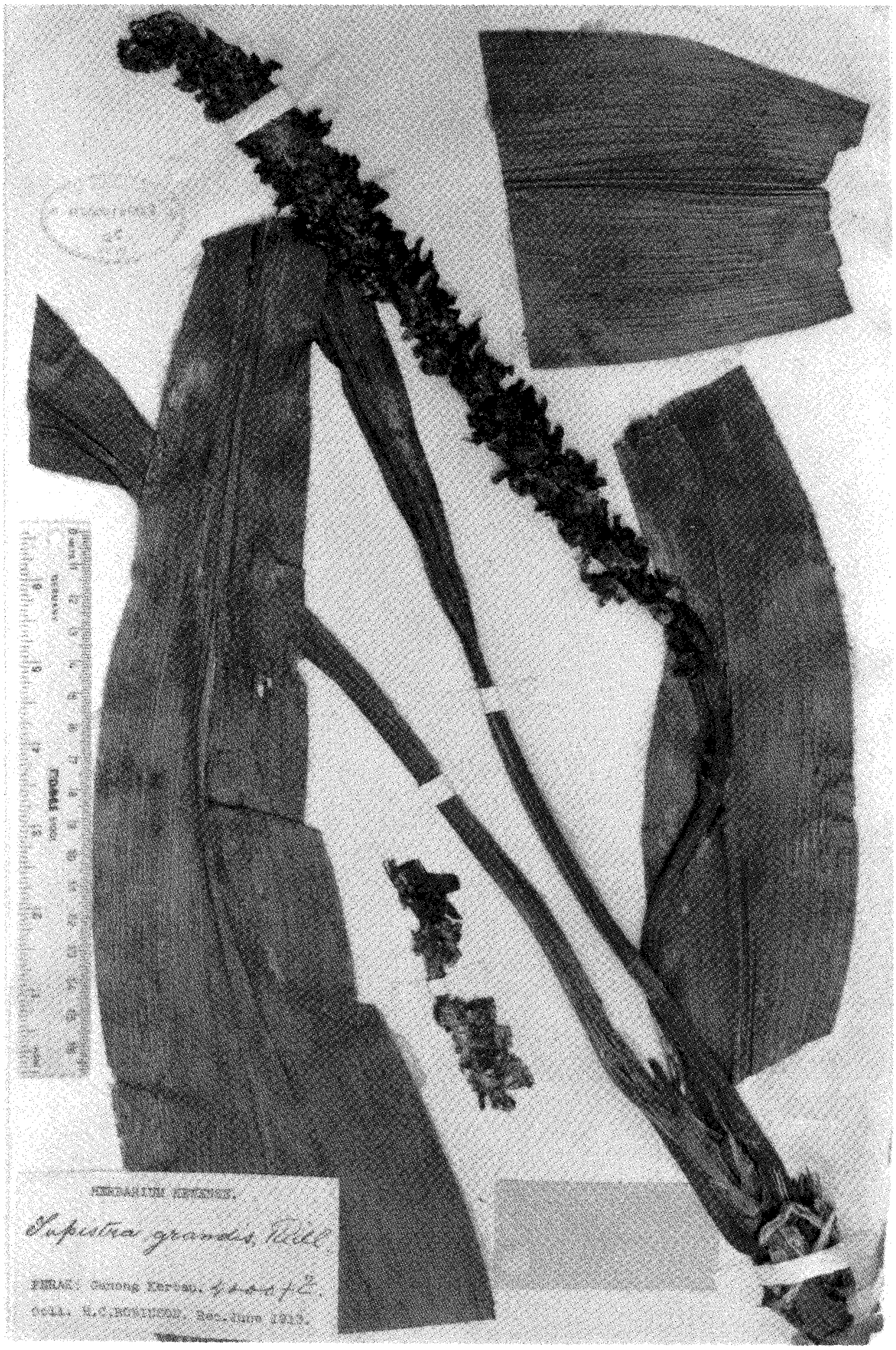

FIG. 3. Holotype of *Tupistra robusta* N. Tanaka from Perak, Malaysia (*H. C. Robinson s.n.*, K).

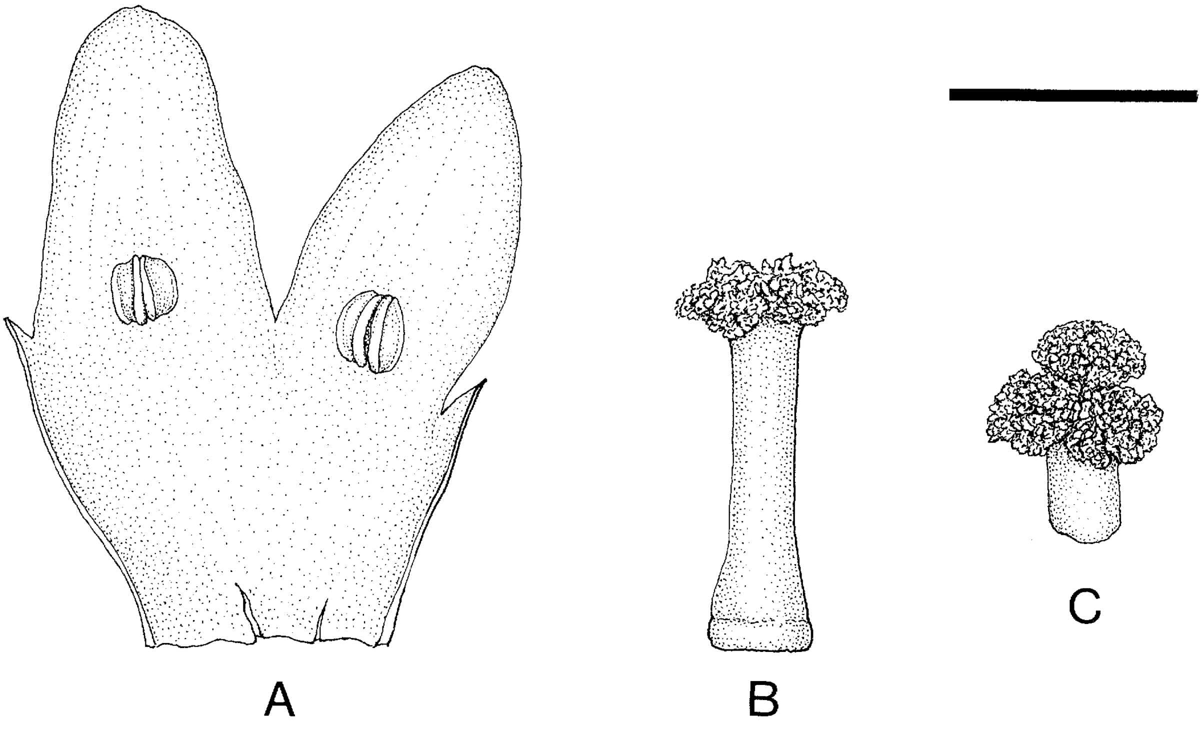

FIG. 4. Partial flower of *Tupistra robusta*. A: part of perianth with two lobes each bearing anther at base. B: pistil in side view. C: distal part of pistil with 3-lobed stigma viewed from above. Scale bar = 5 mm. Drawn from holotype by Noriyuki Tanaka.

3-lobed or somewhat irregularly lobed, irregularly minutely rugose, 3–4.5 mm across, ca. 0.5 mm thick; style terete, 7–8 mm long; ovary superior, slightly turgid, short, 1–1.5 mm long. *Fruit* not seen.

*Flowering*. March.

*Distribution*. Malaysia (Perak).

*Notes*. In *Tupistra robusta*, the anthers are located at the base of the perianth lobes. As in *T. elegans*, the perianth often becomes slightly torn between the lobes when fully expanded, resulting in the anthers appearing to be located subbasally on the lobes.

### 3. **Tupistra malaiana** N. Tanaka, **sp. nov.** (Figs. 5, 6)

*Tupistra violacea* auct. non Ridl.: Tanaka (2003a) in Blumea 48 (3): 506.

Haec species nova *Tupistrae violaceae* subsimilis est, sed ab ea caule florifero assurgenti vel reclinato (vs. caulem floriferum erectum), bracteis florum floribus paulo distantibus (vs. bracteas floribus plerumque approximatas), perianthio urceolato (vs. perianthium campanulatum), antheris insertis parte subdistili tubi perianthii (vs. antheras insertas apice tubi perianthii), et stigmate cum papillis multo minutioribus differt.

*Typus*. THAILAND. Kao Pawta Luang Kao, Ranaung [Ranong], 31 Jan. 1929, fl., *A. F. G. Kerr 16926* (holo-BM; iso- K, P).

*Herb* perennial, evergreen, monopodial, glabrous. *Rhizome* erect, cylindrical, 2 cm in diam. Roots fibrous, to 4 mm in diam. *Cataphylls* several, basal, narrowly deltoid, acute. *Leaves* basal; petiole distinct, 19–30 cm long; blade oblanceolate or narrowly elliptic-oblanceolate, base attenuate, apex slightly acuminate, to 50 cm or longer, 9–14 cm broad. *Floriferous stem* 1, axillary, simple; peduncle to 10 cm long, ascending (sometimes sigmoidally ascending) or reclining, bearing several sterile bracts; bracts acute, to 2.5 cm long; spike densely many-flowered, to ca. 13 cm long. *Bracts* 2 per flower; outer bract inserted below flower, cucullate, ovate or deltoid-ovate, 6–14 mm long, 4–10 mm broad, veins several or many, submembranous (in sicco), upper part not sharply

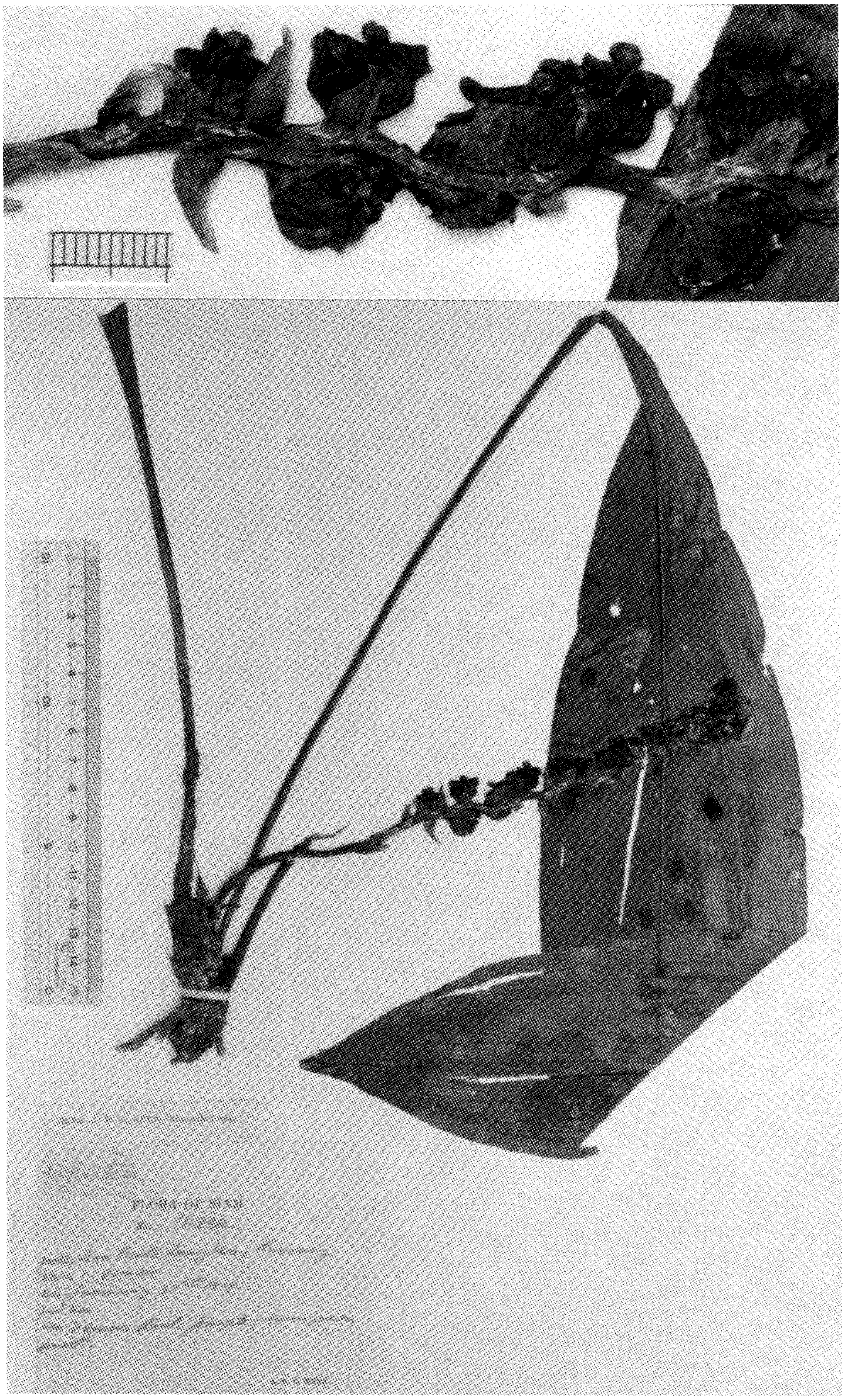

FIG. 5. Holotype of *Tupistra malaiana* N. Tanaka from Ranong, S. Thailand (*A. F. G. Kerr 16926*, BM). Upper inset showing part of spike. Scale in inset in mm.

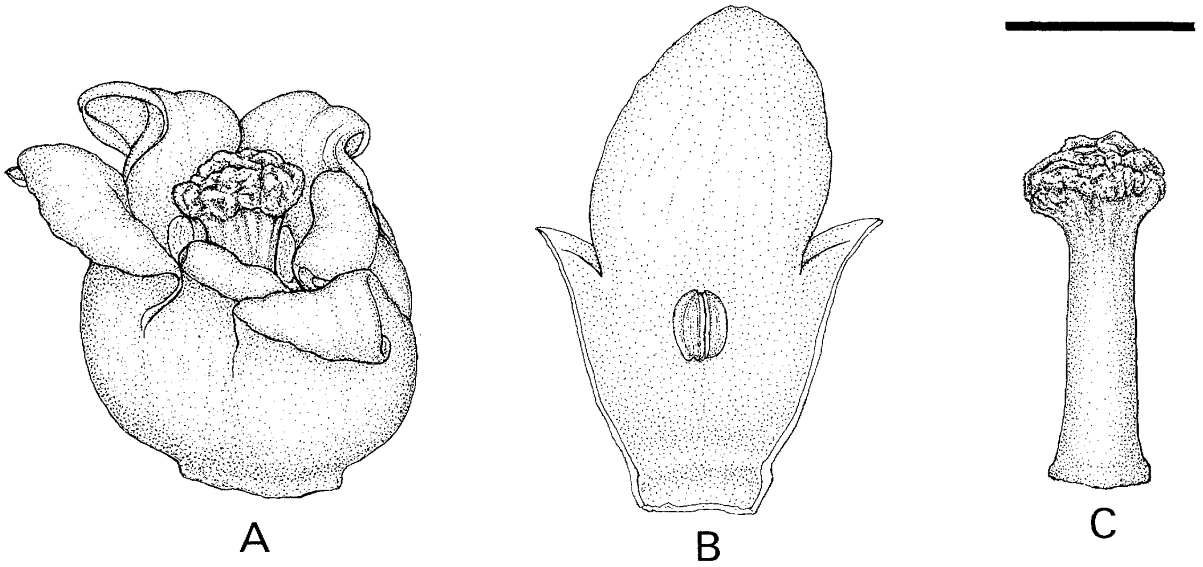

FIG. 6. Flower of *Tupistra malaiana*. A: flower viewed abaxially. B: part of perianth with anther and lobe (extended). C: pistil in side view. Scale bar = 5 mm. A and C from isotype in P, and B from isotype in K. Drawn by Noriyuki Tanaka.

inflexed, as long as or shorter than flowers; inner bract (bracteole) lateral to floral base, ovate, 4–7 mm long, 2.5–6 mm broad. *Flowers* slightly ascending. *Perianth* urceolate, dark purple (*Kerr 16926*), 6-cleft; tube crateriform or turbinate, contracted at base, 4.5–10 mm long; lobes ovate, strongly recurved, basally slightly imbricate, 3.5–8 mm long, 3–7 mm broad, lower (abaxial) 2-4 lobes incurved proximally, narrowing orifice of tube, then recurved. *Stamens* 6; anthers sessile, subdistal on perianth tube, included, introrse, elliptic, 1.5–2 mm long, lower than stigma. *Pistil* 1, 5–10 mm long; stigma subcapitate or shortly clavate, rugose or sometimes lumpy, sometimes shallowly 3-lobed, very finely papillose, 2–3.5(–4) mm across; style terete, 4–7 mm long; ovary superior, ca. 1 mm long. *Fruit* not seen.

*Flowering.* December to February

*Habitat.* Evergreen forests (*Kerr 16929*).

*Distribution.* Thailand (Ranong), Malaysia (Ipoh).

*Other specimens examined.* MALAYSIA. Ipoh: abundant, no date, fl., *C. Curtis s.n.* (SING); Kinta, Dec. 1901, fl., *C. Curtis s.n.* (SING).

Original provenance unknown: cult. in Bot. Gard., Penang, 3815, Jan. 1903, fl., *Collector unknown* (BM); cult. in Hort. Bot. Reg. Kew., A.190, 1907, fl., *Collector unknown* (K).

### 4. **Tupistra kressii** N. Tanaka, **sp. nov.** (Figs. 7, 8)

Haec planta *Tupistrae malaianae* proxima est, sed a qua praecipue differt caule florifero erecto et longiore cum spica densiore (vs. caulem floriferum assurgentem vel reclinatum), bracteis florum flores plerumque excendentibus et eis appressis (vs. bracteas flores vix excendentes et eis paulo distantes), perianthio majore et subzygomorphico cum tubo dorsiventraliter subcomplanato (vs. tubum vix vel minus complanatum), et pistillo longiore.

*Typus.* Southern THAILAND. Yala Province, Ban Nang Sata District, 28 Km E of Ban Nan Sata, 80 m. 24 Apr. 1999, *W. J. Kress* (*with M. Collins & N. Sukhavanich*) *99-6340* (US [3382413]).

*Herb* perennial, monopodial, evergreen, robust, glabrous. *Rhizome* erect, cylindrical, nodose, ligneous, to 4 cm in diam. *Roots* fibrous, to 7 mm in diam. *Cataphylls* several, linear-lanceolate, acute. *Leaves* basal, usually 2 each year, (sub) distichous; petiole stout, adaxially canaliculate; blade oblanceolate, base cuneate, apex acuminate or acute, both surfaces green, subcoriaceous-chartaceous (chartaceous in sicco), abaxial midvein raised, to 75 cm or longer including petiole, to 13 cm broad. *Floriferous stem* 1, axillary,

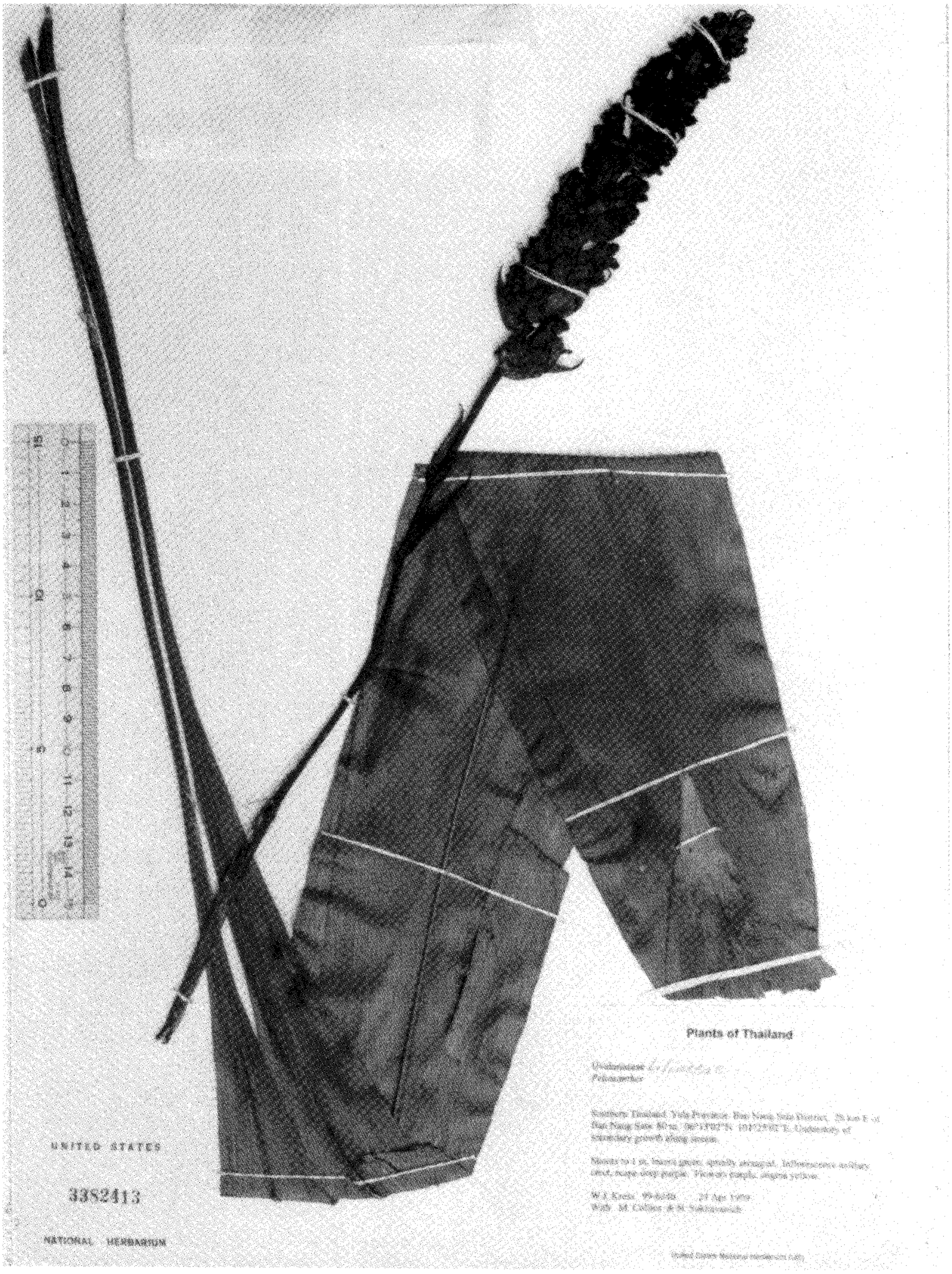

FIG. 7. Holotype of *Tupistra kressii* N. Tanaka from S. Thailand (*W. J. Kress & al. 99-6340*, US 3382413).

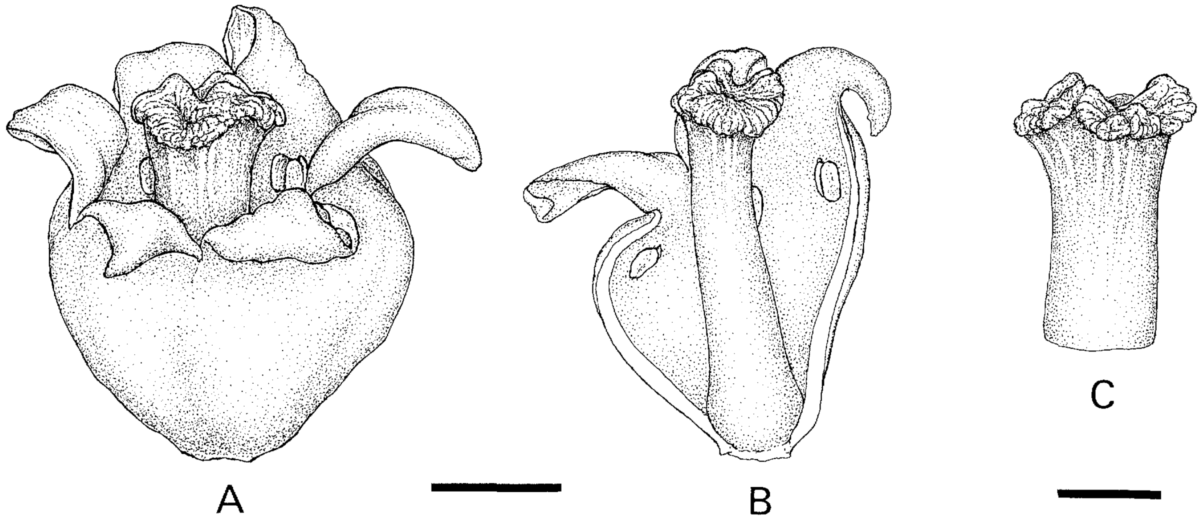

FIG. 8. Flower of *Tupistra kressii*. A: flower viewed abaxially. B: flower longitudinally cut with half of perianth bearing three anthers removed. C: distal part of pistil in side view. Left scale bar = 5 mm for A and B. Right scale bar = 3 mm for C. Drawn by Noriyuki Tanaka from spirit material of *W. J. Kress & al. 99-6340* (A and B, 28 June 2004; C, 23 June 2004, *N. Tanaka s.n.*, TEU).

upright, simple, rachis dark purple, to 38 cm long or longer; peduncle stout, terete, 18–25 cm long, ca. 7 mm in diam.; sterile bracts on peduncle several (to 9), to 4.5 cm long, narrowly lanceolate; spike densely many-flowered, cylindrical, ca. 13 cm long, 2–3 cm broad. *Bracts* 2 per flower, purple to dark purple, (submembranous-)herbaceous, inserted close to flower; outer bract below and appressed to flower, cucullate, narrowly deltoid, acute, apically not sharply inflexed, veins many, usually exceeding flowers; inner bract (bracteole) lateral to floral base, narrowly deltoid-lanceolate, acute, carinate. *Flowers* ascending, nearly zygomorphic. *Perianth* urceolate, fleshy, 6-lobed, subbilabiate; tube subturbinate, somewhat compressed dorsiventrally, more inflated abaxially, contracted distally, glossy, purple, darker above externally, pale purple internally, 10–15 mm long; lobes ovate, deltoid-ovate or oblong-ovate, obtuse, strongly recurved, dark purple, 5.5–8 mm long, 4–6 mm broad. *Stamens* 6; anthers sessile, subdistal on perianth tube, included, introrse, elliptic or subsquare, 1.5–2.3 mm long, cream; pollen pale purplish white. *Pistil* 1, strict, 12–16 mm long; stigma discoid, usually with 3 lumps, finely radiately striate, densely papillose, scented, pale greenish yellow, turning dark brown on second day of anthesis, 3.7–6.5 mm across, slightly exserted from perianth tube, higher than anthers; style terete, incrassate, 2.5–3 mm in diam. in middle, distally minutely papillate and pale greenish yellow, minutely purple dotted subdistally, lower part whitish; ovary superior, nearly as broad as or slightly broader than style, 1.5–2.5 mm long. *Fruit* not seen.

*Flowering*. April to May (or to June under cultivation).

*Habitat*. Understory of secondary growth along streams (*Kress et al. 99-6340*).

*Distribution*. Thailand (Peninsular: Yala).

*Other specimens examined*: S. THAILAND. Provided by USBRG (accession number 1999-094, originally collected by J. Kress *et al*., col. no. 99-6340) and cultivated in nursery of Teikyo University, 23 June 2004 (flowers in spirit), 28 June 2004 (flowers both in spirit and dried), 3 July 2004 (scape, dried), 22 Aug. 2009 (leaf, dried), *N. Tanaka s.n.* (TEU).

*Notes*. It is noteworthy that the stigmas of *Tupistra kressii* are sulfur-colored (or slightly pale greenish yellow) and somewhat scented on the first day of anthesis. In cultivation at our university, the stigmas turned dark brown on the following day. The stigmas may play some role in attracting pollinators, although no field observations have yet been made.

The specific epithet recognizes Dr. W. John Kress, who discovered and collected the type specimen.

### 5. **Tupistra urceolata** N. Tanaka & W. J. Kress, **sp. nov.** (Figs. 9, 10)

Haec species nova *Tupistrae kressii* proxima est, sed a qua praecipue differt pedunculo sine bracteis sterilibus, spica leviter laxiore, bracteis flores non excendentibus et eis non vel vix appressis, tubo perianthii vix complanato (vs. tubum dorsiventraliter subcomplanatum), lobis perianthii quam tubis multo brevioribus, antheris positis quam stigmate vix inferioribus (vs. antheras positas quam stigma insigniter inferiores), et stylo leviter assurgenti cum stigmate minore et tubum perianthii non excendenti.

*Typus*. Cultivated in the greenhouses (USBRG accession no. 1999-080) of the Department of Botany, Smithsonian Institution, 4 May 2004, *W. J. Kress & M. Bordelon s.n.* (US 3448863), originally collected in Waeng District, Naratiwat Province, Thailand, on 23 Apr. 1999 by W. J. Kress (with M. Collins & N. Sukhavanich) no. 99-6325.

*Herb* perennial, monopodial, evergreen, robust. *Rhizome* cylindrical, stout, ca. 2.5 cm in diam. *Roots* fibrous. *Cataphylls* several, basal, narrowly deltoid or lanceolate, acute. *Leaves* basal, 6–7 per shoot (usually 2 produced annually), distichous, oblanceolate, base attenuate, apex acuminate, to 75 cm long or longer including petiole, to 10 cm wide or wider, chartaceous (in sicco). *Floriferous stem* 1, axillary, simple, upright; peduncle stout, dark purple, 25 cm long, lacking sterile bracts, bearing scales at base; spike conical, somewhat laxly flowered, rachis dark purple, ca. 15 cm long. Bracts 2 per flower, to 1.3(-2.3) cm long, usually shorter than flowers, dark purple; outer bract below flower deltoid or deltoid-lanceolate, acute, cucullate, veins many, upper part not sharply inflexed, submembranous-herbaceous; inner bract (bracteole) lateral to floral base, narrowly deltoid or lanceolate, somewhat inequilateral, not imbricate with outer bract except in distal part of spike, abaxial midvein raised. *Flowers* ascending. *Perianth* urceolate, fleshy, 6-lobed; tube obovoid, base somewhat stipe-like, not particularly grooved longitudinally nor dorsiventrally complanate, contracted distally, 11–17 mm long, purple, darker towards apex externally, paler internally; lobes ovate, apex rounded, strongly recurved, 3–6 mm long, 3–6 mm broad, dark purple. *Stamens* 6; anthers sessile, subdistal on perianth tube, included, elliptic, pale cream, (2.2–)2.5–2.8 mm long, nearly as high as stigma. *Pistil* 1, 11–15 mm long, as long as or slightly shorter than perianth tube; stigma disciform, minutely papillate and often with 3 low protrusions on apical ventral surface, 2.5–3.5 mm across; style cylindrical, slightly assurgent, minutely papillate distally, 2.2–3.5 mm broad in middle; ovary superior, slightly broader than style, 1–1.5 mm long. *Fruit* not seen.

*Flowering*. April to May.

*Habitat*. Understory of evergreen wet forests along streams; 115 m elevation (data from greenhouse records of Department of Botany, Smithsonian Institution).

*Distribution*. Thailand (Peninsular: Naratiwat).

*Other specimen examined*. Cultivated in the greenhouse of the Botany Department, Smithsonian Institution (USBRG accession number 1999-080, originally collected by W. J. Kress & al., col. no. 99-6325), two flowers, May 2004, *Leslie Brothers s.n.* (TEU).

## Discussion

Five new species described above can be placed into two groups.

One group comprises *Tupistra elegans* (Figs. 1, 2) and *T. robusta* (Figs. 3, 4), appearing to be closely allied. They share a sigmoid floriferous stem, a campanulate perianth with anthers located around the orifice of the perianth tube, and an umbraculate, lobed stigma. They also appear to be closely related to *T. violacea*, which is, like them, indigenous to the Malay Peninsula, and has a campanulate perianth with anthers located at the apex of the tube. *Tupistra violacea* differs from them by its upright floriferous stem, subglobose stigma and crateriform perianth tube.

The other group comprises *Tupistra malaiana* (Figs. 5, 6), *T. kressii* (Figs. 7, 8) and *T. urceolata* (Figs. 9, 10). These species share an urceolate perianth with anthers inserted subdistally on the tube. In *Tupistra*, all other species have a cam-

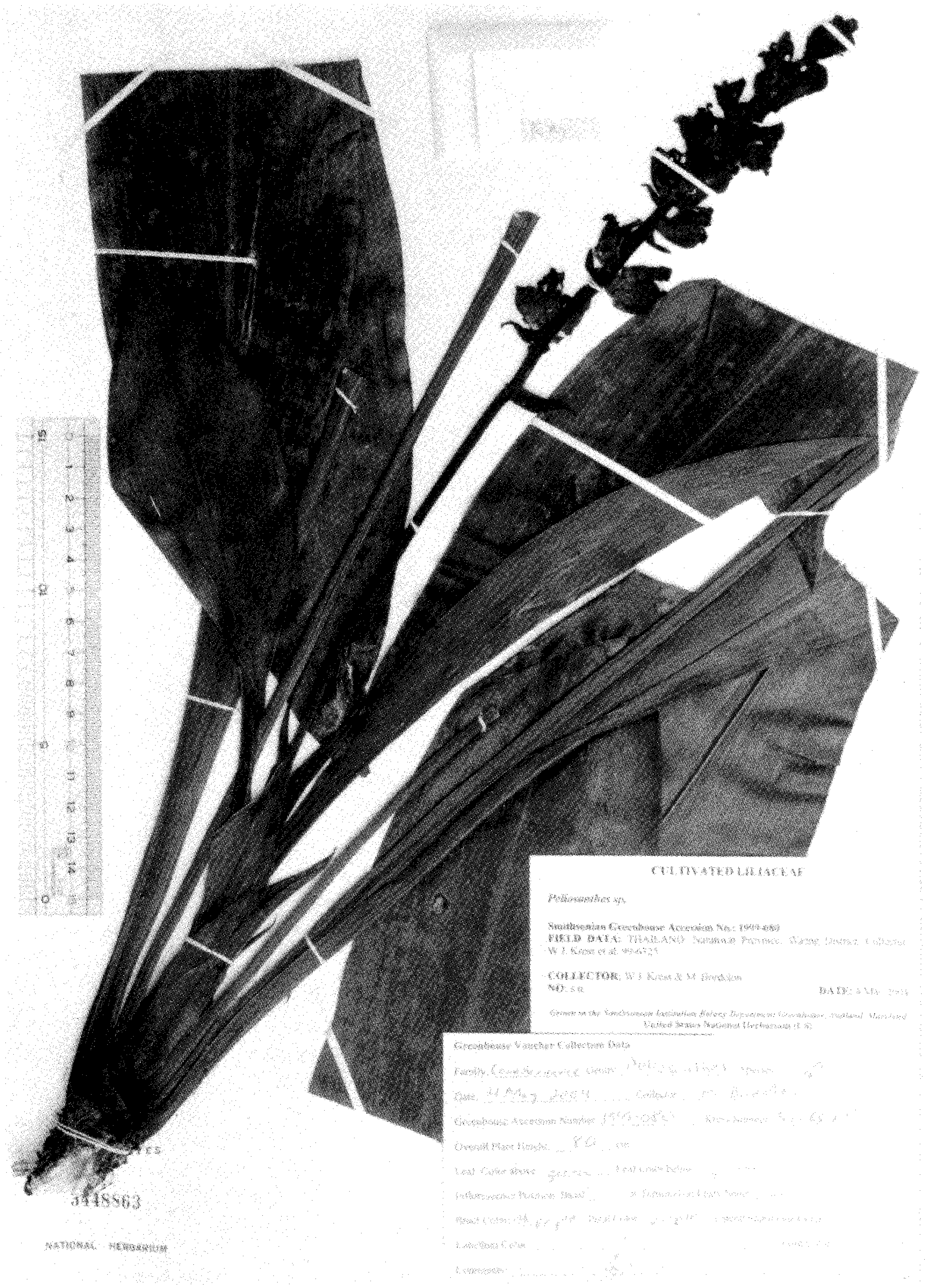

FIG. 9. Holotype of *Tupistra urceolata* N. Tanaka & W. J. Kress from S. Thailand (*W. J. Kress & M. Bordelon s.n.*, US [3448863]), from living stock of W. J. Kress & al. 99-6325.

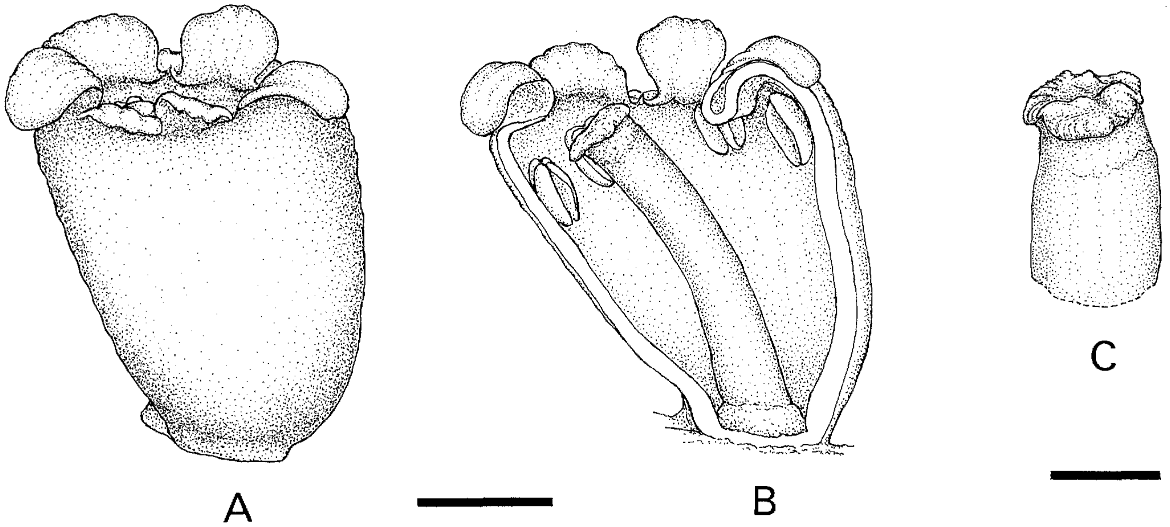

FIG. 10. Flower of *Tupistra urceolata*. A: flower in side view. B: flower longitudinally cut with part of perianth bearing two anthers removed. Style slightly assurgent, and four anthers inserted subdistally on perianth tube. C: distal part of pistil. Left scale bar = 5 mm for A and B.Right scale bar = 3 mm for C. A and B from *L. Brothers s.n.* (May 2004, TEU), and C from holotype. Drawn by Noriyuki Tanaka.

panulate perianth. The urceolate perianth is, therefore, very likely to be an apomorphy derived from a campanulate one. In this interpretation, the three species are monophyletic, as they share the apomorphy.

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